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IoT BASED ECG MONITORING USING ARDUINO

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Abstract

Recent technologies are mainly concentrating on life saving innovations and in disease prevention. In this paper, we have developed a device for monitoring the cardiac activities of a patient who has been affected by heart diseases. The measurement of biological parameters is very essential for maintaining the cardiac patient's health. Heartbeat sensor was used for sensing heart rate (pulse rate) of a person. ECG sensor was used to measure the electrical activity of heart. Thus we measure the body parameters like heart beat and ECG. The expansion and contraction of the heart forces the blood to flow through the arteries. From this, the pulse rate can be detected by sensing the areas where the artery is close to the skin. The signals from the sensors are send to arduino with the help of serial communication ports. The arduino processes the digital signals from the sensors and performs the heart beat and ECG monitoring. The data has been send to the doctors mobile with the help of bluetooth module. This device is cost effective and it can easily used by the patient who has the risk of cardiac attack..

Keywords: ECG, Arduino,Bluetooth module

1. Introduction

Electrode deals with the study of electrical activity of the heart muscle. The potentials originated in individual heart muscles are added to produce the ECG waveform. Electro Cardiogram is the recorded ECG wave pattern. It reflects the rhythmic electrical Depolarization and Repolarization of heart muscles. Any form of Arrhythmia can be easily

diagnosed using ECG.The complete waveform is called Electrocardiogram with the labels PQRSTU indicating important diagnostic features. If the PR interval is more than 0.22s, the AV Block occurs. When the QRS complex duration is more than 0.1s, the Bundle Block occurs. Surface electrodes are used with the jelly type electrolyte between skin and electrode. Potential distribution changes in a regular and complex manner during each Cardiac cycle.

Prajakta A. Pawar proposed heart rate monitoring system using IR base sensor and arduino UNO. This system is used to monitor the heartbeat of a person. The measured data is send to the doctor through the SMS with the help of GSM module. The digital signals from the sensors are given to the arduino. The heart beat sensor used here consist of LED which transmits red bright light and it acts as a transmitting part. A detector is used as a receiving part which absorbs signals from the LED. A finger is placed between the LED and the detector. From this they are calculating the number of times persons heart beats per minute[1].

Slomi S. Thomas , Mr.Amar saraswat, Anurag Shashwat , Dr. Vishal Bharti proposed sensing heart beat and body temperature digitally using arduino. The heart rate and temperature is measured in this paper. The heart beat sensor is used for monitoring the heart rate and the temperature sensor LM35 is used for measuring the temperature of a person. The digital signals from the sensors are given to the serial ports of arduino microcontroller. This device is mainly used for measuring the mean arterial pressure (MAP) in about one minute and the accurate body temperature. The data is send to a mobile phone with the help of bluetooth module. The results will be displayed in the android[2].

G.Vijay kumar, A.Bharadwaja, N.Nikhil sai proposed a Temperature and heartbeat monitoring system using IOT. The temperature and heartbeat of a person is monitored in this paper. The sensors are used for receiving the signals from the physical environment and processes the signal into digital output in the arduino 8051 microcontroller. The results are send to the doctor through the internet of things. In this paper, they have analysed the results of various age group of people[3].

Arulananth.T.S, B.Shilpa proposed a fingertip based heart beat monitoring systems using embedded systems. In this system, they measured the heart rate by using the Photo Plethysmography(PPG) technique. It is a non-invasive method for measuring the blood volume in tissues of a person. Itconsists of a light source and detector for counting the heart rate. Through optical sensing mechanism, the fluctuation of blood around the fingertip is detected. The amplified signals are send to the serial ports of the arduino. Then the output is displayed in LCD[4].

2. Hardware Setup

1. ECG which is used for the measurement of the heart pulses in the body.
2. ARDUINO for interfacing the ECG signal to the electrical output.
3. Bluetooth setup for sending the message to the mobile phone.
4. Alarm for detecting whenever the patient becomes abnormal.

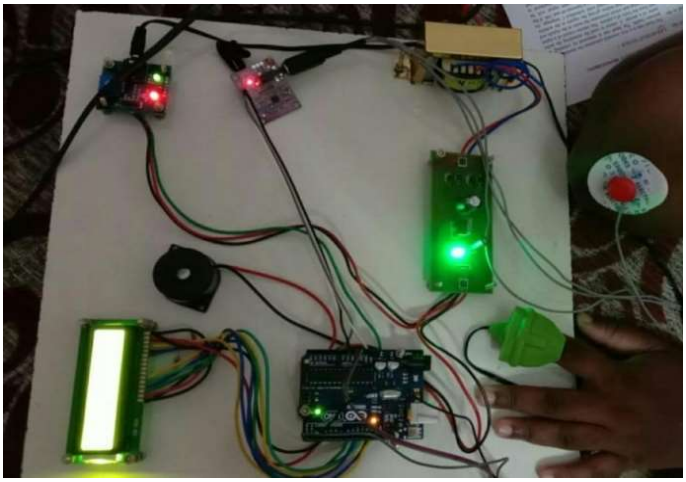


Fig.1. Hardware Setup

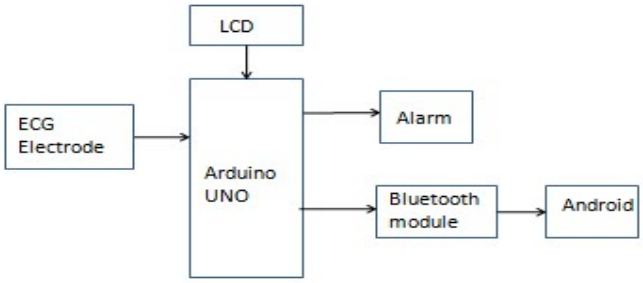


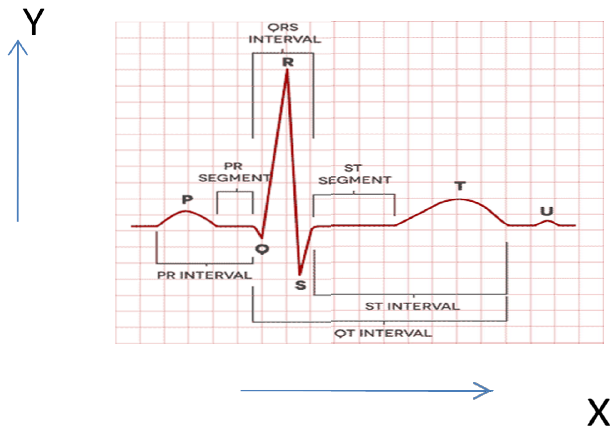
Fig.2. Block Diagram

3. Cardiac Activity Monotoring

3.1. ECG ELECTRODE

An electrocardiogram (ECG or EKG, abbreviated from the German *Electrocardiogram*) is a graphic produced by an electrocardiograph, which records the electrical activity of the heart over time. ECG sensors are mainly used for monitoring the electrical activity of heart. The ECG sensors are made with filters and limb leads. Modern ECG monitors offer multiple filters for signal processing. The most common settings are monitor mode and diagnostic mode. In monitor mode, the low frequency filter (also called the *high-pass filter* because signals above the threshold are allowed to pass) is set at either 0.5 Hz or 1 Hz and the high frequency filter (also called the *low-pass filter* because signals below the threshold are allowed to pass) is set

at 40 Hz. This limits artifact for routine cardiac rhythm monitoring. The low frequency (high-pass) filter helps reduce wandering baseline and the high frequency (low pass) filter helps reduce 60 Hz power line noise. In diagnostic mode, the low frequency (high pass) filter is set at 0.05 Hz, which allows accurate ST segments to be recorded.



In this circuit there are three electrode is used to measure the ECG waves in which two electrode is fixed with left and right hand another one electrode is fixed in the right leg which acts as reference ground electrode. Electrode 1 and Electrode 2 pick up the ECG waves from the both hands. Then the ECG waves are given to instrumentation amplifier section.

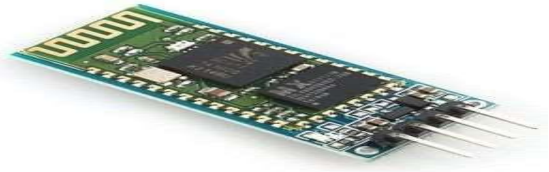
The instrumentation amplifier is constructed by the TL 072 operational amplifier. The TL072 are high speed J-FET input dual operational amplifier incorporating well matched, high voltage J-FET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset current and low offset voltage temperature coefficient. Figure 3.6 shows the pin diagram of instrumentation amplifier which amplifies the differential signal from all the electrodes.

The amplified ECG waves contains the line frequency, high and low frequency noise signals. So the ECG wave is fed to filter section. The filter section consists of high pass filter and low pass filter which is used to remove the high frequency and low frequency noise signal. After the filteration the ECG wave is given to pulse width modulation unit. In this section the ECG wave is converted into pulse format in order to perform the isolation. The isolation is construct by the opto coupler. The isolation is necessary to isolate the human body and monitoring equipment such as CRO, PC etc.Then the ECG pulse format wave is given to PWM demodulation unit in which the pulse format is reconstruct to original wave. Then the

wave is fed to notch filter section in order to remove the line frequency noise signal. A notch filter is a band-stop filter with a narrow stopband (high Q factor). Notch filters are used in live sound reproduction (Public Address systems, also known as PA systems) and in instrument amplifier (especially amplifiers or preamplifiers for acoustic instruments such as acoustic guitar, mandolin, bass instrument amplifier, etc.) to reduce or prevent feedback, while having little noticeable effect on the rest of the frequency spectrum. Other names include 'band limit filter', 'T-notch filter', 'band-elimination filter', and 'band-rejection filter'.

3.2. Bluetooth Module

Bluetooth is a telecommunications industry specification that describes how mobile phones, computers, and Personal Digital Assistant (PDA) can be easily interconnected using a short-range wireless connection. A Bluetooth device uses radio waves instead of wires or cables to connect to a phone or computer . Bluetooth is low power, easy to use and low cost. HC-05 is a embedded Bluetooth serial communication mode. The network ranges from two to eight connected devices. When a network is established, one device takes the role of the master while all the other devices act as slaves. The output data as continuously send to the doctor's mobile with the help of bluetooth module.



3.3. Alarm

Buzzer or beeper is a signaling device. This device was based on an electromechanical system which was identical to an electric bell without the metal gong which makes the ringing noise. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which a preset value has lapsed sounds a warning in the form of a continuous or intermittent buzzing or beeping sound is product.

4. Experimental Result

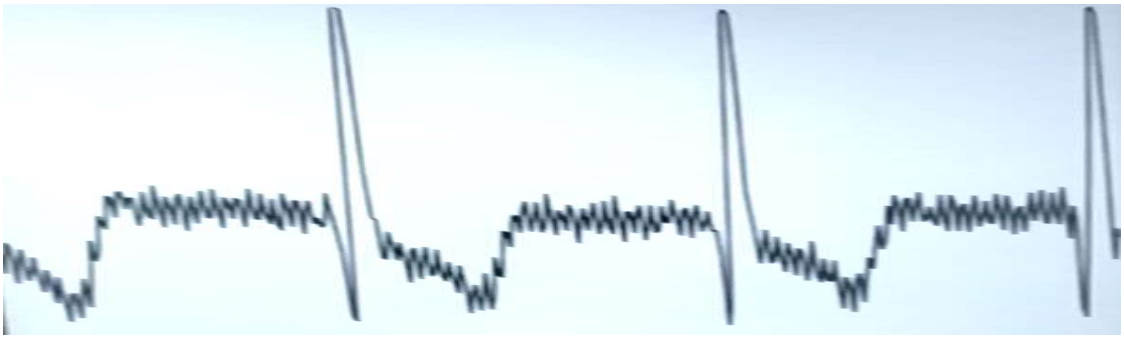


Fig.4. ECG waveform

5. Conclusion

This device is very helpful for elderly people for monitoring their health by themselves and to improve their quality of life. This device is simple to use and anyone can use it in an easy manner. The person can monitor their health before the occurrence of any risk . This device is cost effective and consumes very low power.

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